

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year) 14 May 2001 (14.05.01)	
International application No. PCT/GB00/03547	Applicant's or agent's file reference SPG/P36131WO
International filing date (day/month/year) 15 September 2000 (15.09.00)	Priority date (day/month/year) 16 September 1999 (16.09.99)
Applicant SMITH, Steve	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 11 April 2001 (11.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Zakaria EL KHODARY Telephone No.: (41-22) 338.83.38
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(19) World Intellectual Property Organization
International Bureau



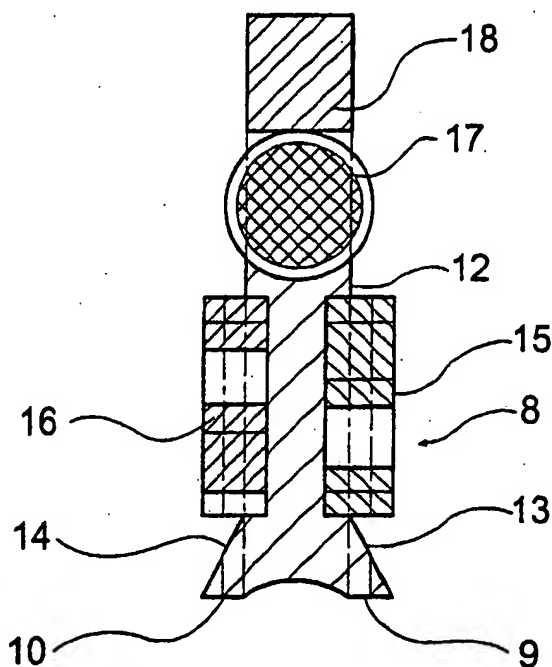
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9921791.1 16 September 1999 (16.09.1999) GB
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
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- Published:
— With international search report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SEAL ASSEMBLY



(57) Abstract: There is described a seal assembly and a method of sealing parallel, planar, arcuate or convex surfaces. The seal assembly comprises a ring seal provided with a pair of primary sealing lips (9, 10), radially disposed on a first, circumferential face of the ring (8); a second, radial face (13, 14) being provided with means (15, 16) for dispersing pressurised fluid. There is also provided a method of introducing a three way joint into a pipeline.

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SEAL ASSEMBLY

This invention relates to a novel seal assembly.

5 Natural gas is commonly transported, in bulk, across land through large diameter (eg 24 inch) steel pipelines. It is not uncommon to introduce offtakes or three way joints at certain points on the main transmission pipeline. Currently, a three way joint is welded into the pipeline, following the removal of a section of pipe. This procedure when carried out with gas loaded into the line is hazardous and expensive, involving
10 the installation of a secondary "loop" through which to bypass the gas whilst the joint is installed.

We have now found a novel form of seal which is capable of acting as a primary sealing element that can provide a seal between a main transmission line and bonded
15 branch connection. The seal must withstand service and test pressure including pressure reversals and must also be able to accommodate eccentricity of the branch connection to the main pipeline.

Copending British Patent Application No. 9917 360.1 describes a novel method of
20 securing a branch assembly to a pipeline. Such a method requires a specialised seal which is not only adapted to operate under significant pressures but can also be fitted to non-planar or arcuate surfaces.

British Patent Application No. 1214986 describes a sealing means for use with a pair
25 of pipes which are angularly movable relative to each other. Generally, the sealing means comprises an annular body portion and a pair of spaced tongues, the tongues being provided with inwardly inclined ears. However, the seal described therein is designed for use in connection with "parallel" pipeline flange joints. The seal does not provide a solution to the problem of forming a fluid tight seal in a branched
30 pipeline.

Thus it is known to use "U" ring seals in pressure systems wherein the pressure acts on the side wall of the U ring. However, we have now surprisingly found a novel seal assembly which is sufficiently flexible so as to be adaptable to fit parallel, planar, arcuate or convex surfaces.

5

Thus according to the invention we provide a seal assembly adapted for use in a pressurised system which comprises a ring seal provided with at least a pair of primary sealing lips radially disposed on a first, circumferential, face of the ring, the second, radial face of the ring seal being provided with means for dispersing

10. pressurised fluid.

In a preferred embodiment of the invention the means for dispersing pressurised fluid comprises means for dispensing pressure in a circumferential and a radial direction.

15 The seal of the invention is advantageous in that it is especially useful in pressure systems since the pressure acts on the walls of the lips and the portion of the seal joining the lips to enhance the pressurised fluid seal produced. The seal will hereinafter be described as a radial U ring seal.

20 In conventional land based pipe lines the pressure differential is such that the internal face of the seal experiences greater pressure than the external face. Thus, in such an embodiment, the first circumferential face of the seal is the inner face and the second circumferential face is the outer face.

25 In a further embodiment of the invention the seal arrangement may be such that the external pressure on the seal is greater than the internal pressure. Such seals are, for example, advantageous in that they may be suitable for sub-sea pipelines.

In an alternative embodiment of the invention for use in sub-sea applications, it may
30 be necessary to provide means of sealing to prevent the ingress of water which may be (at times) at a higher pressure than the pipeline fluid. In this case a pair of primary

sealing lips may be radially disposed from an outer circumferential face of the ring, whilst means for dispersing pressurised fluid is provided on the inner radial face of the ring.

- 5 The dispersing means may comprise a labyrinth seal, which may be located on the radial face of the seal. In a preferred embodiment both radial faces of the radial U ring seal are provided with a pressurised fluid dispersing member, in which case the labyrinth seals may be the same or different.
- 10 Labyrinth seals are known to cause reductions in pressure across the radial width of the seal. Thus, the labyrinth seals used may comprise an array of apertures. Alternatively, the labyrinth seals may only be partially cut through such that the seal comprises a plurality of hollows or holes. The apertures or holes (together referred to as "the bulkheads") may be arranged irregularly or preferably, in a regular pattern.
- 15 When a regular pattern is used a 'brick-bond' pattern is preferred, that is, the bulkheads are offset in relation to one another. On opposite sides of the seal faces the bulkheads may be circumferentially offset to one another, for example, by half the pitch of the bulkhead. Alternatively, the bulkheads may not necessarily be offset. Although it is within the scope of the present invention for the labyrinth seals to be
- 20 separate to the radial U ring seal, or to be bonded to the radial U ring seal, it is preferred that the labyrinth seal is an integral part of the radial U ring seal. When the apertures or holes are in a regular pattern they may comprise two or three circumferential rows. Two circumferential rows are preferred.
- 25 The thickness of the labyrinth seal may vary, but is preferably from 1 to 5mm, more preferably from 1.0 to 2.5 mm. The dimensions of the apertures or holes may also be varied depending upon, *inter alia*, the pressure which the seal is subjected to, the material of which the seal comprises, etc. However, it is preferred that the apertures or holes have a depth of from 0.5 to 2.0 mm and more preferably from 1.0 to 1.5 mm.
- 30 For ease of manufacturing the apertures or holes are preferably substantially the same size and shape and may be substantially rectangular with dimensions of from 5 to

10 mm radial width by 15 to 20 mm circumferential length, preferably 8 by 16 mm. When rectangular apertures/holes are used then the longest side is preferably circumferential.

- 5 Any conventionally known materials may be used in the manufacture of the seals of the invention and preferably the labyrinth seal portion comprises the same material as the U ring portion of the seal. Such materials include elastomers and/or plastics. Examples of elastomers include, but are not limited to rubbers, e.g. natural or synthetic rubbers. Of these synthetic rubbers are preferred such as nitrile rubbers, eg
- 10 acrylonitrile butadiene copolymer (NBR), hydrogenated acrylonitrile butadiene rubber (HNBR), fluoroelastomers (FKM), such as Viton or perfluoroelastomers (FFKM), such as Kalrez. (Viton® and Kalrez® are available from Du Pont Dow Elastomers). Examples of plastics materials include fluorinated polymers such as PTFE (polytetrafluoroethylene).

15

The hardness of the elastomer, e.g. HNBR, may be varied. However, it is preferred that the hardness lies in the range of from 50 to 95 degrees Shore A.

- The pressure which the seals of the invention are designed to tolerate may be up
- 20 to 110 bar under test conditions and from 20 to 70 bar under conventional operating conditions. Moreover the seals of the invention may withstand external pressures of up to 350 bar, e.g. from 20 to 350, preferably from 70 to 300, more preferably from 105 to 180 bar.

- 25 Under operating conditions there may be a risk of circumferential extrusion between the outer portion of the seal and the pipes. Thus, in a preferred embodiment a reinforcement member around the outer circumference of the seal eg a coiled spring. The spring is preferentially a metal spring eg a steel spring.

- 30 Furthermore, since the seal assembly is free to continually expand in a radial direction under the working pressure acting on the lips of the seal. Thus, in a

preferred embodiment of the invention the seal may be provided with a containment member. Such a containment member preferentially comprises a metal ring situated on the non-pressure facing surface of the seal. The containment member may optionally be integral to the seal ring or may be separate.

5

Thus in land based pipelines the containment member is preferentially on the outer surface of the seal ring. However, for use in connection with sub-sea pipelines, the containment member is preferentially on the inner surface of the seal ring.

10 In systems where the pressure differential across the seal may be variable and/or in sub-sea applications a plurality of seal rings of the invention may be used. For example, an outermost seal may comprise a seal with outer facing sealing lips and an innermost seal may comprise a seal with inner facing sealing lips. In such a system the innermost and outermost seals may be separate, but may or may not be positioned
15 adjacent to each other.

However, in a yet further embodiment of the invention a seal is provided wherein the seal comprises an innermost seal and an outermost seal which share a common containment member.

20

Thus according to a further feature of the invention we provide a seal assembly adapted for use in a prescribed system which comprises a pair of primary sealing lips radially disposed on an inner circumferential face of the seal ring, the primary and secondary lips being connected by a containment member.

25

In a preferred embodiment of the invention the seal is provided with means for dispersing pressurised fluid as hereinbefore described. Further the seal assembly as hereinbefore may comprise a single common containment member

30 The common containment member may optionally be integral to the ring seals or may be separate.

The seal assembly of the invention finds utility particularly as large pipeline seals such as may be required in the oil, chemical, water or gas fields. They are capable of sealing surfaces which are parallel; non-parallel, eg by up to 5mm; or , arcuately eccentric, as may be found when a portion of the side wall of a pipe may be cut away.

- 5 The seals are especially useful in introducing, for example, a three way joint, into a pipeline by connecting two pipes.

Thus the seal assembly may be suitable for use in land based pipelines or sub-sea pipelines.

10

According to a further feature of the invention we provide a method of introducing a three way joint into a pipeline which comprises a hole in a pipe and attaching a second pipe over the hole wherein the seal of the invention lies between the two pipes.

15

- We further provide a method as hereinbefore described which is suitable for use in a variable pressure system, such as a sub-sea system. Such a method may comprise using a plurality of seals of the invention. The method especially comprises using an outermost seal which may be provided with outer facing sealing lips and an innermost seal which may be provided with inner facing sealing lips. In such a system the innermost and outermost seals may be separate, but may or may not be positioned adjacent to each other.
- 20

- The invention will now be described by way of example only and with reference to the accompanying drawings in which;
- 25

Figure 1 is a perspective view of a segment of a conventionally used U ring;

Figure 2 is a perspective view of a segment of a radial U ring seal of the invention;

- Figure 3 is a cross-section of a segment of a radial U ring seal provided with a labyrinth seal;
- 30

Figure 4 is a cross-section of the complete seal of the invention;

Figure 5 is a plan view of the complete seal of the invention;

Figure 6 is a cross-section of the seal of the invention for use in sub-sea pipelines; and

Figure 7 is a cross-section of a branched sub-sea pipeline using the seals of the invention; and

Figure 8 is a cross-section of a dual seal assembly.

Referring to Figure 1 a conventional U ring seal (which is not of the invention) a seal (1) comprises lips (2 and 3) and lip joining section (4) and a body (5). The body (5) has outer walls (6 and 7). The seal (1) which is shown in segment only, is substantially circular such that the wall (6) is on the inside of the circle and the wall (7) on the outside of the circle.

With reference to Figure 2, a radial U ring lip seal (8) comprises lips (9 and 10), a lip joining section (11) and a body (12). The body (12) has outer faces (13 and 14). The seal (8) is substantially circular such the lips (9 and 10) face inwards towards the centre.

With reference to Figures 3 to 5, a lip seal (8) comprises lips (9 and 10), the body (12) of the seal being provided with labyrinth seals (15 and 16) on each face (13 and 14) respectively. The labyrinth seals (15 and 16) are in a "brickwork" arrangement. The body (12) of the seal (8) is provided with a support ring (17) in the form of a coiled spring moulded into the seal body (12). The seal (8) is also provided with a containment ring (18) on the face outermost from the centre.

25

With reference to Figure 6, a sub-sea lip seal (10) comprises lips (20 and 21), the body of the seal being provided with labyrinth seals (not shown) as hereinbefore described. The lips (20 and 21) are positioned on the outer facing surface (22) of the seal (19). The body is provided with a support ring (23) and optionally with a containment member (not shown).

30

With reference to Figure 7, a sub-sea pipeline (24) comprises a main pipe body (25) and a branched pipe (26). The main pipe (25) is provided with an aperture (27) which is coincident with the branched pipe (26). The branched pipe (26) is provided with a flange (28) which overlies the main pipe (25). The gap (29) between the flange (28) and the main pipe body (25) is plugged with seal (30) and seal (31a). Seal (30) is provided with inward facing lips (32) which acts to prevent leakage from inside the pipeline (24). Seal (31) is provided with outward facing lips (33) which acts to prevent leakage into the pipeline (24) if the external pressure is greater than the internal pressure.

10

With reference to Figure 8, a radial U ring (34) is adapted for use in a variable pressure system. The seal (34) comprises a pair of inner facing lips (35 and 36) attached to a first body portion (37). The body (37) is provided with a support ring (38) and a containment ring (39) and the containment ring (39) is adjacent the support ring (39). The containment ring (39) may be integral to the support ring (38), or may be, for example, fixed onto the support rings (38), or may simply be sandwiched into position.

The containment ring (39) has a first face (40) which abuts or is connected to the support ring (38) and a second opposite face (41). The second face (41) is situated adjacent to a second support ring (42), the support ring (42) being attached to a second body (43) which is provided with lips (44 and 45).

Each of the bodies (37 and 43) is provided with labyrinth seals (46, 47, 48, 49) on the respective radial faces (50, 51, 52, 53).

CLAIMS

1. A seal assembly adapted for use in a pressurised system which comprises a seal ring provided with at least a pair of primary sealing lips radially disposed on a first, circumferential, face of the ring; a second, radial, face of the ring seal being
5 provided with means for dispersing pressurised fluid.
2. A seal assembly according to claim 1 characterised in that the means for dispersing the pressurised fluid comprises means for dispersing pressure in a circumferential direction.
10
3. A seal assembly according to claim 2 characterised in that the means for dispersing the pressurised fluid comprises means for dispersing pressure in a circumferential direction and a radial direction.
15
4. A seal assembly according to claim 1 characterised in that the means for dispersing the pressurised fluid is a labyrinth seal located on the radial side face.
5. A seal assembly according to claim 1 characterised in that the first circumferential face of the seal is the inner face and the second circumferential face is the outer face.
20
6. A seal assembly according to claim 1 characterised in that the seal is adapted to be used in a system wherein the external pressure on the seal is greater than the internal pressure.
25
7. A seal assembly according to claim 6 characterised in that the primary sealing lips are radially disposed from an outer circumferential face of the ring, whilst means for dispersing pressurised fluid is provided on the inner radial face of the ring.
30

8. A seal assembly according to claim 1 characterised in that both outer side faces of the radial U ring seal are provided with a pressurised fluid dispersing means.

5 9. A seal assembly according to claim 7 characterised in that the labyrinth seal comprises a plurality of apertures.

10. A seal assembly according to claim 7 characterised in that the labyrinth seal comprises a plurality of holes.

10 11. A seal assembly according to claims 9 or 10 characterised in that the apertures or holes are arranged in a regular pattern.

12. A seal assembly according to claim 11 characterised in that the regular pattern is a 'brick-bond' pattern.

15 13. A seal assembly according to claim 1 characterised in that the means for dispersing the pressurised fluid an integral part of the radial face of the seal ring.

14. A seal assembly according to claim 12 characterised in that the apertures or
20 holes are in a regular pattern of two or three circumferential rows.

15. A seal assembly according to claim 14 characterised in that the apertures or holes are in a regular pattern of two circumferential rows.

25 16. A seal assembly according to claims 9 or 10 characterised in that the apertures or holes are from 0.5 to 2.0mm deep.

17. A seal assembly according to claims 9 or 10 characterised in that the apertures or holes are preferably substantially the same size and shape.

30

18. A seal assembly according to claim 1 characterised in that the assembly is adapted to tolerate from 20 to 70 bar under conventional operating conditions.

19 A seal assembly according to claim 1 characterised in that the seal is provided
5 with a containment member.

20. seal assembly according to claim 1 characterised in that the containment member is on the outer surface of the ring seal.

10 21 A seal assembly according to claim 1 characterised in that the containment member is on the inner surface of the ring seal.

22. seal assembly according to claim 21 characterised in that the containment member comprises a reinforcement member around the outer circumference of the
15 seal.

23. A seal assembly according to claim 1 characterised in that the reinforcement member is preferentially a coiled spring.

20 24. A seal assembly according to claim 1 characterised in that the seal is provided with a containment ring around the outer circumference of the seal.

25. A seal assembly which comprises a pair of primary sealing lips radially disposed on an inner circumferential face of the ring seal, the primary and secondary
25 lips being connected by a containment member.

26. A method of introducing a three way joint into a pipeline which comprises a hole in a pipe and attaching a second pipe over the hole wherein the seal of the invention lies between the two pipes.

30

27. A method according to claim 26 characterised in that the method comprises using a plurality of seals according to claim 1.

28. A method according to claim 27 characterised in that the method comprises
5 using an outermost seal which is provided outer facing sealing lips and an innermost seal which is provided with inner facing sealing lips.

29. A method according to claim 20 characterised in that the innermost and
10 outermost seals are separate.

30. A seal assembly substantially as described with reference to the
15 accompanying examples.

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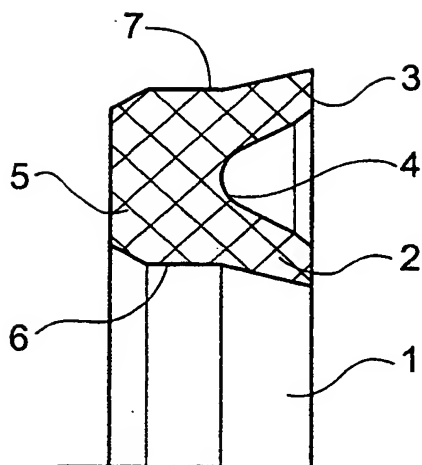


Fig. 1

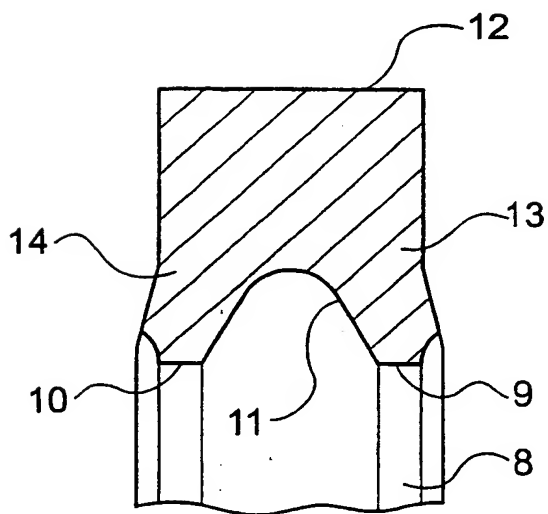


Fig. 2

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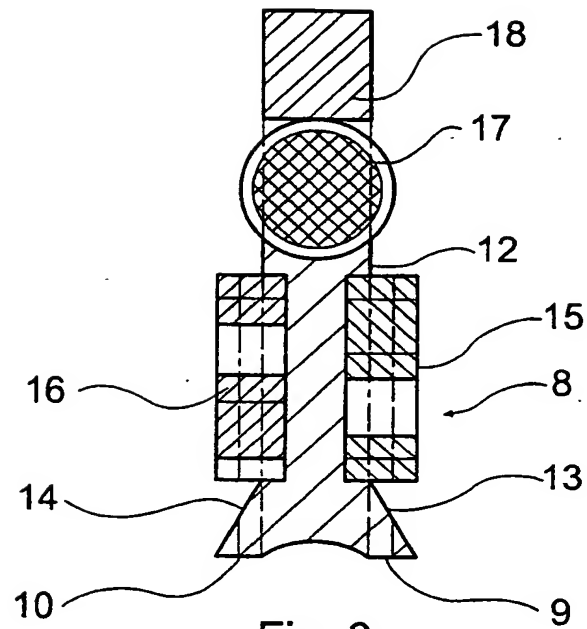


Fig. 3

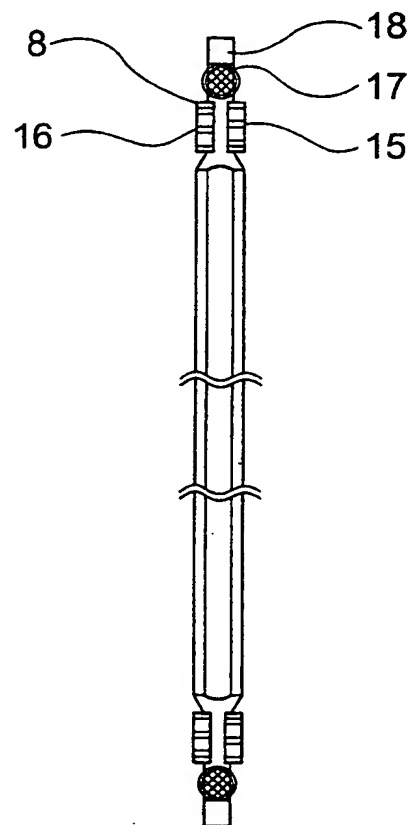


Fig. 4

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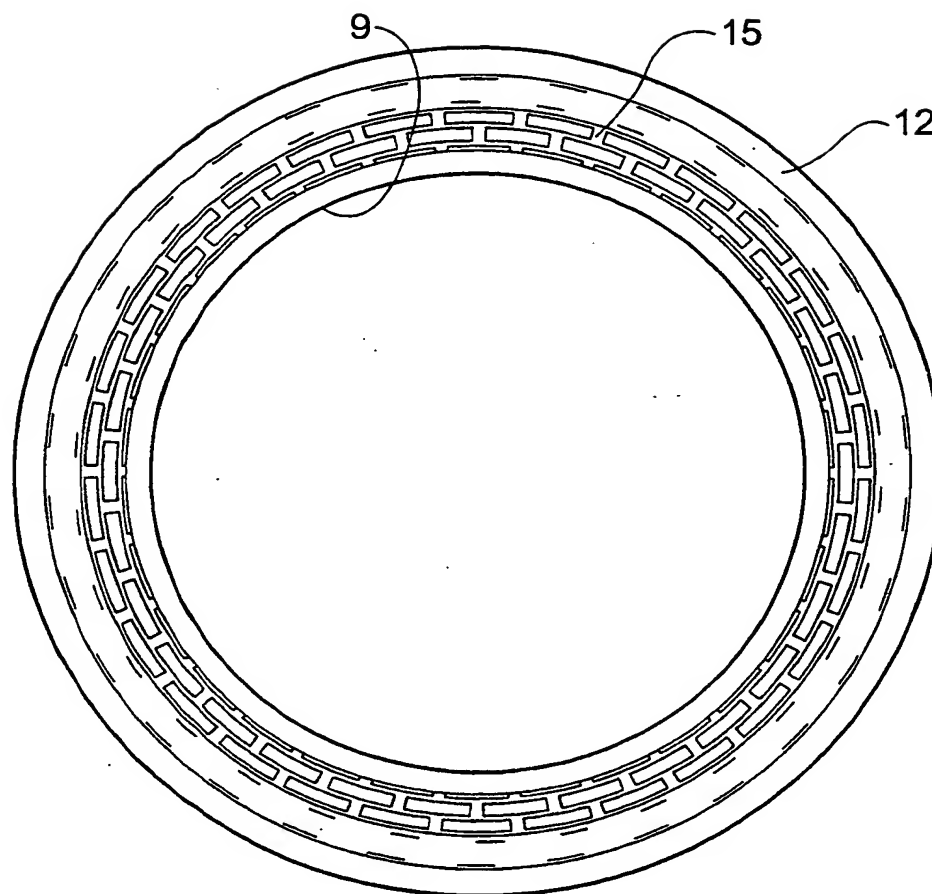


Fig. 5

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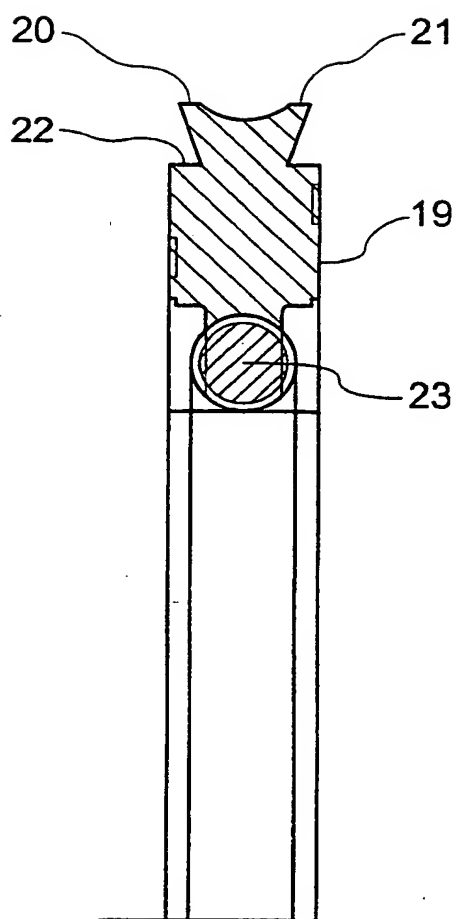


Fig. 6

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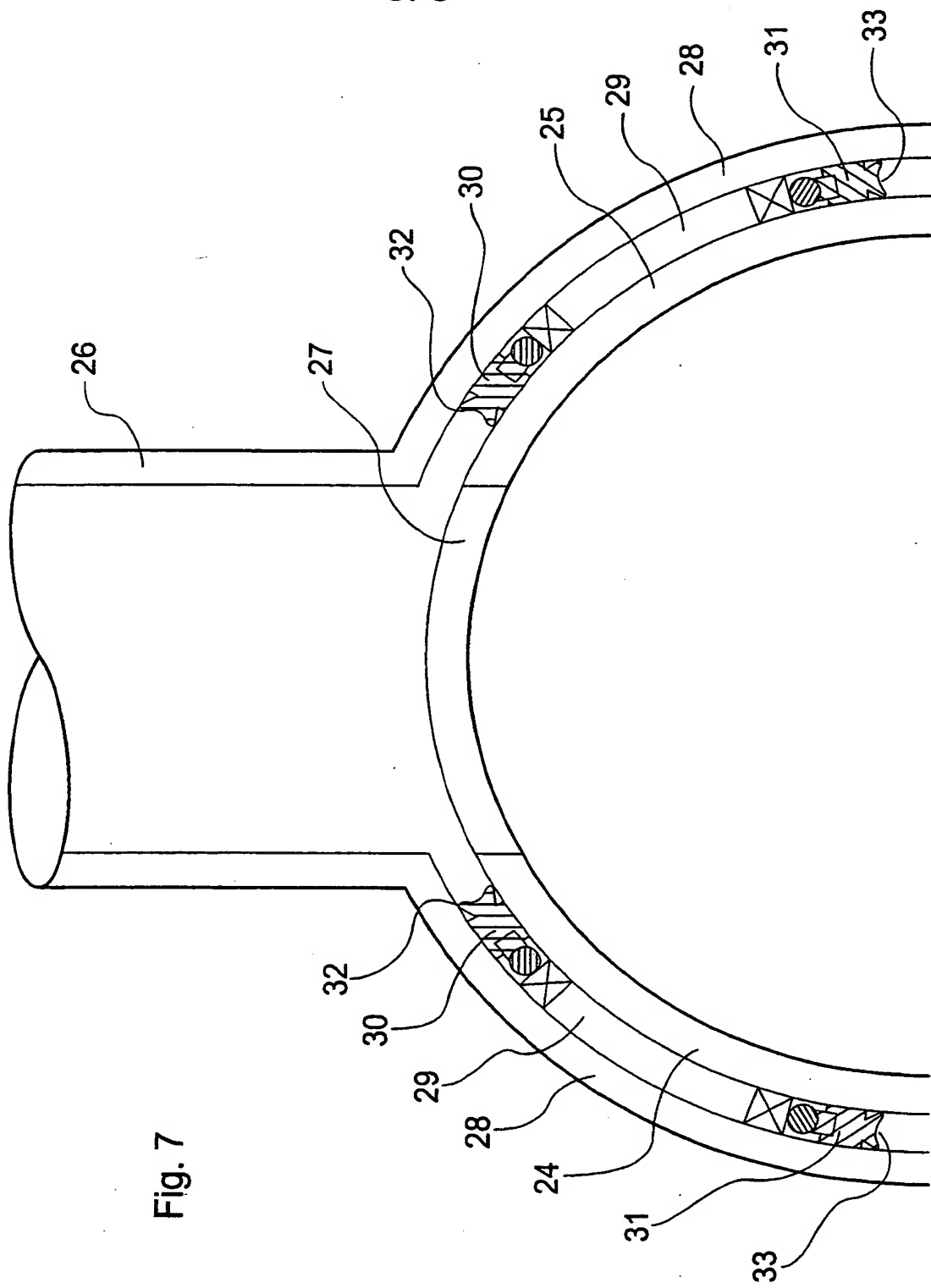


Fig. 7

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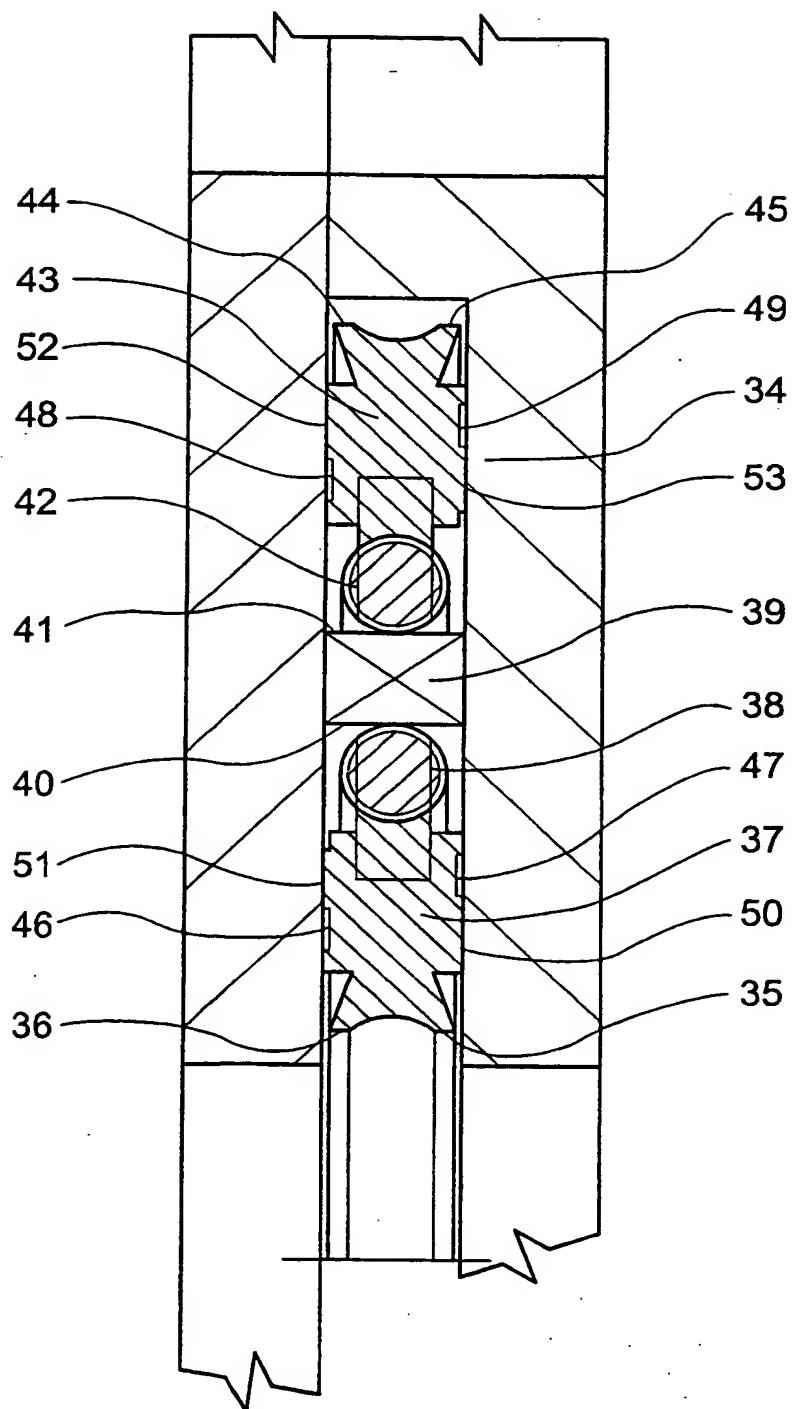


Fig. 8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03547

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16J15/12 F16L41/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16J F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 549 562 A (CEA) 13 December 1968 (1968-12-13) page 2, left-hand column, line 48 - line 60; figure 2	1,2,5-8, 13,18, 19,25
X	GB 1 214 986 A (BAL) 9 December 1970 (1970-12-09) cited in the application page 1, line 55 - page 2, line 23; figure	1,2
A	US 5 040 828 A (KANE) 20 August 1991 (1991-08-20) column 2, line 47 - line 64; figures 2,3	1,21,22, 26



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

29 November 2000

Date of mailing of the international search report

06/12/2000

Name and mailing address of the ISA

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Authorized officer

Narminio, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internat'l Application No

PCT/GB 00/03547

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1549562	A	13-12-1968	NONE
GB 1214986	A	09-12-1970	NONE
US 5040828	A	20-08-1991	NONE

REC'D 07 JAN 2002

WIPO

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SPG/P36131WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/03547	International filing date (day/month/year) 15/09/2000	Priority date (day/month/year) 16/09/1999
International Patent Classification (IPC) or national classification and IPC F16J15/12		
Applicant FTL SEALS TECHNOLOGY LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 6 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 13 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 11/04/2001	Date of completion of this report 03.01.2002
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Jest, Y Telephone No. +49 89 2399 8425 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03547

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-9 as received on 16/10/2001 with letter of 10/10/2001

Claims, No.:

1-29 as received on 16/10/2001 with letter of 10/10/2001

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

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☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 29.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 29 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

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- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.
- 2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees. .
- 3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
 - ☐ complied with.
 - ☒ not complied with for the following reasons:
see separate sheet
- 4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
 - ☒ all parts.
 - ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-23,25-28
	No:	Claims	24
Inventive step (IS)	Yes:	Claims	1-23,25-28
	No:	Claims	24
Industrial applicability (IA)	Yes:	Claims	1-28
	No:	Claims	

2. Citations and explanations **see separate sheet**

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item III

Independent claim 29 does not comply with Rule 6.2a) PCT and no opinion may be given therefore.

Re Item IV

There is no common inventive concept between the subject-matter of claim 1 and the one of independent claim 24. The inventive feature of claim 1 relates to the labyrinth seal as means for dispersing fluid pressure while claim 24 defines a containment ring member.

Re Item V

1) To independent claims 1, 24 and 25.

- 1.1) All the features of the preamble of claim 1 may be recognised in the prior art document **FR-A- 1 549 562 (FR)**, see especially the embodiment of fig.2, or **GB-A- 1 214 986 (GB)**, see especially the drawing. The grooves provided on the radial faces of these seals are considered to be suitable for dispersing pressurised fluid.

The difference of the claimed assembly and method is that the means for dispersing the pressurised fluid is a labyrinth seal located on the axial end face. Labyrinth seals are of course well-known in the art but there is no indication in the cited prior art to locate such a labyrinth seal on said face of the assembly in order to disperse the pressurised fluid.

The assembly of claim 1 and the method of claim 25 thus meet the requirements of Art. 33(1) PCT.

- 1.2) Independent claim 24 is drafted in such a broad and speculative way that it covers many constructional arrangements which are however in no way disclosed or suggested in the description (see also comments in item VIII below). Its subject-matter has not been limited to a construction having a radial sealing ring comprising a labyrinth seal for dispersion of the pressure but refers to merely a vague and imprecise definition of a "containment ring".

The features of claim 24 may be recognised in FR or GB so that the requirements of Art. 33(1) are not met.

2) To the remaining dependent claims 2-23 and 26-28.

These claims are dependent either on claim 1 or on claim 25 so that the requirements of Art. 33(1) PCT are met.

Re Item VIII

- 1) There is an inconsistency between **claim 24** and the description which leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear (Article 6 PCT).
The containment member according to the description and drawings is for instance member 18 in fig.3, which is not the joining section 11 connecting the lips of the seal.
Additionally claim 24 does not relate to the inventive idea of a labyrinth seal for dispersing the fluid pressure so that it lacks an essential feature.
- 2) In claims 2,3,6,7,12 feature "means for dispersing pressurised fluid" is no longer correct and should read "labyrinth seal" (Art.6 PCT).
- 3) In the description, page 3, line 12, the labyrinth seal is presented as being optional which is in clear contradiction with the definition given by the claims (Art. 6 PCT).

SEAL ASSEMBLY

This invention relates to a novel seal assembly.

5 Natural gas is commonly transported, in bulk, across land through large diameter (eg 24 inch) steel pipelines. It is not uncommon to introduce offtakes or three way joints at certain points on the main transmission pipeline. Currently, a three way joint is welded into the pipeline, following the removal of a section of pipe. This procedure when carried out with gas loaded into the line is hazardous and expensive, involving
10 the installation of a secondary "loop" through which to bypass the gas whilst the joint is installed.

We have now found a novel form of seal which is capable of acting as a primary sealing element that can provide a seal between a main transmission line and bonded
15 branch connection. The seal must withstand service and test pressure including pressure reversals and must also be able to accommodate eccentricity of the branch connection to the main pipeline.

Copending British Patent Application No. 9917 360.1 describes a novel method of
20 securing a branch assembly to a pipeline. Such a method requires a specialised seal which is not only adapted to operate under significant pressures but can also be fitted to non-planar or arcuate surfaces.

British Patent Application No. 1214986 describes a sealing means for use with a pair
25 of pipes which are angularly movable relative to each other. Generally, the sealing means comprises an annular body portion and a pair of spaced tongues, the tongues being provided with inwardly inclined ears. However, the seal described therein is designed for use in connection with "parallel" pipeline flange joints. The seal does not provide a solution to the problem of forming a fluid tight seal in a branched
30 pipeline.

French Patent Application No. 1549562 describes a seal assembly which comprises a pair of circumferential grooves which are adapted to prevent the ingress of fluid.

5 Thus it is known to use "U" ring seals in pressure systems wherein the pressure acts on the side wall of the U ring. However, we have now surprisingly found a novel seal assembly which is sufficiently flexible so as to be adaptable to fit parallel, planar, arcuate or convex surfaces.

10 Thus according to the invention we provide a radial sealing ring assembly adapted for use in a pressurised system which comprises a radial sealing ring provided with at least a pair of primary sealing lips radially disposed on a first, circumferential, face of the ring, a second, axial end face of the radial sealing ring being provided with means for dispersing pressurised fluid characterised in that the means for dispersing the pressurised fluid is a labyrinth seal located on the axial and face.

15 In a preferred embodiment of the invention the means for dispersing pressurised fluid comprises means for dispersing pressure in a circumferential and a radial direction.

20 The seal of the invention is advantageous in that it is especially useful in pressure systems since the pressure acts on the walls of the lips and the portion of the seal joining the lips to enhance the pressurised fluid seal produced. The seal will hereinafter be described as a radial sealing ring.

25 In conventional land based pipe lines the pressure differential is such that the internal face of the seal experiences greater pressure than the external face. Thus, in such an embodiment, the first circumferential face of the seal is the inner face and the second circumferential face is the outer face.

30 In a further embodiment of the invention the seal arrangement may be such that the external pressure on the seal is greater than the internal pressure. Such seals are, for example, advantageous in that they may be suitable for sub-sea pipelines.

In an alternative embodiment of the invention for use in sub-sea applications, it may be necessary to provide means of sealing to prevent the ingress of water which may be (at times) at a higher pressure than the pipeline fluid. In this case a pair of primary
5 sealing lips may be radially disposed from an outer circumferential face of the radial sealing ring, whilst means for dispersing pressurised fluid is provided on the inner axial end face of the radial sealing ring.

The dispersing means may comprise a labyrinth seal, which may be located on the
10 axial end face of the seal. In a preferred embodiment both axial end faces of the radial sealing ring are provided with a pressurised fluid dispersing member, in which case the labyrinth seals may be the same or different.

Labyrinth seals are known to cause reductions in pressure across the axial end face of
15 the seal. Thus, the labyrinth seals used may comprise an array of apertures. Alternatively, the labyrinth seals may only be partially cut through such that the seal comprises a plurality of hollows or holes. The apertures or holes (together referred to as "the bulkheads") may be arranged irregularly or preferably, in a regular pattern. When a regular pattern is used a 'brick-bond' pattern is preferred, that is, the
20 bulkheads are offset in relation to one another. On opposite sides of the seal faces the bulkheads may be circumferentially offset to one another, for example, by half the pitch of the bulkhead. Alternatively, the bulkheads may not necessarily be offset. Although it is within the scope of the present invention for the labyrinth seals to be separate to the radial sealing ring, or to be bonded to the radial sealing ring, it is
25 preferred that the labyrinth seal is an integral part of the radial sealing ring. When the apertures or holes are in a regular pattern they may comprise two or three circumferential rows. Two circumferential rows are preferred.

The thickness of the labyrinth seal may vary, but is preferably from 1 to 5mm, more
30 preferably from 1.0 to 2.5 mm. The dimensions of the apertures or holes may also be varied depending upon, *inter alia*, the pressure which the radial sealing ring is

subjected to, the material of which the seal comprises, etc. However, it is preferred that the apertures or holes have a depth of from 0.5 to 2.0 mm and more preferably from 1.0 to 1.5 mm. For ease of manufacturing the apertures or holes are preferably substantially the same size and shape and may be substantially rectangular with
5 dimensions of from 5 to 10 mm radial width by 15 to 20 mm circumferential length, preferably 8 by 16 mm. When rectangular apertures/holes are used then the longest side is preferably circumferential.

Any conventionally known materials may be used in the manufacture of the seals of
10 the invention and preferably the labyrinth seal portion comprises the same material as the U ring portion of the radial sealing ring. Such materials include elastomers and/or plastics. Examples of elastomers include, but are not limited to rubbers, e.g. natural or synthetic rubbers. Of these synthetic rubbers are preferred such as nitrile rubbers, eg acrylonitrile butadiene copolymer (NBR), hydrogenated acrylonitrile
15 butadiene rubber (HNBR), fluoroelastomers (FKM), such as Viton or perfluoroelastomers (FFKM), such as Kalrez. (Viton® and Kalrez® are available from Du Pont Dow Elastomers). Examples of plastics materials include fluorinated polymers such as PTFE (polytetrafluoroethylene).

20 The hardness of the elastomer, e.g. HNBR, may be varied. However, it is preferred that the hardness lies in the range of from 50 to 95 degrees Shore A.

The pressure which the seals of the invention are designed to tolerate may be up 105 to 110 bar under test conditions and from 20 to 70 bar under conventional operating
25 conditions. Moreover the seals of the invention may withstand external pressures of up to 350 bar, e.g. from 20 to 350, preferably from 70 to 300, more preferably from 105 to 180 bar.

Under operating conditions there may be a risk of circumferential extrusion between
30 the outer portion of the seal and the pipes. Thus, in a preferred embodiment a

support ring is provided around the outer circumference of the seal eg a coiled spring. The spring is preferentially a metal spring eg a steel spring.

5 Furthermore, since the radial sealing ring assembly is free to continually expand in a radial direction under the working pressure acting on the lips of the seal. Thus, in a preferred embodiment of the invention the radial sealing ring may be provided with a containment ring. Such a containment ring preferentially comprises a metal ring situated on the non-pressure facing surface of the seal. The containment ring may optionally be integral to the seal ring or may be separate.

10

Thus in land based pipelines the containment ring is preferentially on the outer surface of the radial sealing ring. However, for use in connection with sub-sea pipelines, the containment ring is preferentially on the inner surface of the radial sealing ring.

15

In systems where the pressure differential across the radial sealing ring may be variable and/or in sub-sea applications a plurality of radial sealing rings of the invention may be used. For example, an outermost radial sealing ring may comprise a radial sealing ring with outer facing sealing lips and an innermost radial sealing ring may comprise a radial sealing ring with inner facing sealing lips. In such a system the innermost and outermost radial sealing rings may be separate, but may or may not be positioned adjacent to each other.

20

However, in a yet further embodiment of the invention a radial sealing ring is provided wherein the seal comprises an innermost radial sealing ring and an outermost radial sealing ring which share a common containment ring.

25

Thus according to a further feature of the invention we provide a radial sealing ring assembly adapted for use in a prescribed system which comprises a pair of primary sealing lips radially disposed on an inner circumferential face of the radial sealing ring, the primary and secondary lips being connected by a containment ring member.

30

In a preferred embodiment of the invention the radial sealing ring is provided with means for dispersing pressurised fluid as hereinbefore described. Further the radial sealing ring assembly as hereinbefore may comprise a single common containment
5 ring.

The common containment ring may optionally be integral to the radial sealing rings or may be separate.

10 The radial sealing ring assembly of the invention finds utility particularly as large pipeline seals such as may be required in the oil, chemical, water or gas fields. They are capable of sealing surfaces which are parallel; non-parallel, eg by up to 5mm; or, arcuately eccentric, as may be found when a portion of the sidewall of a pipe may be cut away. The radial sealing rings are especially useful in introducing, for example, a
15 three way joint, into a pipeline by connecting two pipes.

Thus the radial sealing ring assembly may be suitable for use in land based pipelines or sub-sea pipelines.

20 According to a further feature of the invention we provide a method of introducing a three way joint into a pipeline which comprises a hole in a pipe and attaching a second pipe over the hole wherein the radial sealing ring of the invention lies between the two pipes.

25 We further provide a method as hereinbefore described which is suitable for use in a variable pressure system, such as a sub-sea system. Such a method may comprise using a plurality of radial sealing rings of the invention. The method especially comprises using an outermost radial sealing ring which may be provided with outer facing sealing lips and an innermost radial sealing ring which may be provided with
30 inner facing sealing lips. In such a system the innermost and outermost radial sealing rings may be separate, but may or may not be positioned adjacent to each other.

The invention will now be described by way of example only and with reference to the accompanying drawings in which;

Figure 1 is a perspective view of a segment of a conventionally used U ring;

5 Figure 2 is a perspective view of a segment of a radial U ring seal Figure 3 is a cross-section of a segment of a radial sealing ring provided with a labyrinth seal of the invention

Figure 4 is a cross-section of the complete seal of the invention;

Figure 5 is a plan view of the complete seal of the invention;

10 Figure 6 is a cross-section of the seal of the invention for use in sub-sea pipelines; and

Figure 7 is a cross-section of a branched sub-sea pipeline using the seals of the invention; and

Figure 8 is a cross-section of a dual seal assembly.

15

Referring to Figure 1 a conventional U ring seal (which is not of the invention) a seal (1) comprises lips (2 and 3) and lip joining section (4) and a body (5). The body (5) has outer walls (6 and 7). The seal (1) which is shown in segment only, is substantially circular such that the wall (6) is on the inside of the circle and the wall (7) on the outside of the circle.

20

With reference to Figure 2, a radial U ring seal (8) (which is not of the invention) comprises lips (9 and 10), a lip joining section (11) and a seal body (12). The seal body (12) has axial end faces (13 and 14). The seal (8) is substantially circular such the lips (9 and 10) face inwards towards the centre.

25

With reference to Figures 3 to 5, a radial sealing ring (8) comprises lips (9 and 10), the seal body (12) of the seal being provided with labyrinth seals (15 and 16) on each axial end face (13 and 14) respectively. The labyrinth seals (15 and 16) are in a "brick-bond" arrangement. The seal body (12) of the radial sealing ring (8) is provided with a support ring (17) in the form of a coiled spring moulded into the seal

30

body (12). The radial sealing ring (8) is also provided with a containment ring (18) on the second or outer circumferential face which is outermost from the centre.

5 With reference to Figure 6, a sub-sea radial sealing ring (19) comprises primary sealing lips (20 and 21), the body of the seal being provided with labyrinth seals (not shown) as hereinbefore described. The primary sealing lips (20 and 21) are positioned on the outer facing circumferential surface (22) of the radial sealing ring (19). The body is provided with a support ring (23) and optionally with a containment ring (not shown).

10

With reference to Figure 7, a sub-sea pipeline (24) comprises a main pipe body (25) and a branched pipe (26). The main pipe (25) is provided with an aperture (27) which is coincident with the branched pipe (26). The branched pipe (26) is provided with a flange (28) which overlies the main pipe (25). The gap (29) between the
15 flange (28) and the main pipe body (25) is plugged with radial sealing ring (30) and radial sealing ring (31). Radial sealing ring (30) is provided with inward facing lips (32) which act to prevent leakage from inside the pipeline (24). Radial sealing ring (31) is provided with outward facing lips (33) which act to prevent leakage into the pipeline (24) if the external pressure is greater than the internal pressure.

20

With reference to Figure 8, a radial sealing ring (37) is adapted for use in a variable pressure system. The radial seal ring (34) comprises a pair of inner facing lips (35 and 36) attached to a first seal body portion (37). The seal body (37) is provided with a support ring (38) and a containment ring (39) and the containment ring (39) is
25 adjacent the support ring (38). The containment ring (39) may be integral to the support ring (38), or may be, for example, fixed onto the support ring (38), or may simply be sandwiched into position.

The containment ring (39) has a first face (40) which abuts or is connected to the
30 support ring (38) and a second opposite face (41). The second face (41) is situated

adjacent to a second support ring (42), the support ring (42) being attached to a second seal body (43) which is provided with lips (44 and 45).

Each of the bodies (37 and 43) is provided with labyrinth seals (46, 47, 48, 49) on the
5 respective axial end faces (50, 51, 52, 53).

10 P36131WO.6

CLAIMS

1. A radial sealing ring assembly (8) adapted for use in a pressurised system which comprises a radial sealing ring provided with at least a pair of primary sealing
5 lips (9 and 10) radially disposed on a first, circumferential, face (13) of the ring; a second, axial end, face (14) of the radial sealing ring being provided with means for dispersing pressurised fluid characterised in that the means for dispersing the pressurised fluid is a labyrinth seal (15 or 16) located on the axial end face (14).
- 10 2. A radial sealing ring assembly (8) according to claim 1 characterised in that the means for dispersing the pressurised fluid comprises means for dispersing pressure in a circumferential direction.
3. A radial sealing ring assembly (8) according to claim 2 characterised in that
15 the means for dispersing the pressurised fluid comprises means for dispersing pressure in a circumferential direction and a radial direction.
4. A radial sealing ring assembly (8) according to claim 1 characterised in that
20 the first circumferential face of the radial sealing ring is the inner face and the second circumferential face is the outer face.
5. A radial sealing ring assembly (8) according to claim 1 characterised in that
25 the radial sealing ring is adapted to be used in a system wherein the external pressure on the radial sealing ring is greater than the internal pressure.
6. A radial sealing ring assembly (8) according to claim 5 characterised in that
30 the primary sealing lips (9 and 10) are radially disposed from an outer circumferential face of the radial sealing ring, whilst means for dispersing pressurised fluid is provided on the axial end face of the radial sealing ring.

7. A radial sealing ring assembly (8) according to claim 1 characterised in that both axial end faces of the radial sealing ring are provided with a pressurised fluid dispersing means (15 and 16).
- 5 8. A radial sealing ring assembly (8) according to claim 6 characterised in that the labyrinth seal (15 and 16) comprises a plurality of apertures.
9. A radial sealing ring assembly (8) according to claim 6 characterised in that the labyrinth seal (15 and 16) comprises a plurality of holes.
- 10 10. A radial sealing ring assembly (8) according to claims 8 or 9 characterised in that the apertures or holes are arranged in a regular pattern.
11. A radial sealing ring assembly (8) according to claim 10 characterised in that
15 the regular pattern is a 'brick-bond' pattern.
12. A radial sealing ring assembly (8) according to claim 1 characterised in that the means for dispersing the pressurised fluid is an integral part of the axial end face of the radial sealing ring.
- 20 13. A radial sealing ring assembly (8) according to claim 11 characterised in that the apertures or holes are in a regular pattern of two or three circumferential rows.
14. A radial sealing ring assembly (8) according to claim 13 characterised in that
25 the apertures or holes are in a regular pattern of two circumferential rows.
15. A radial sealing ring assembly (8) according to claims 8 or 9 characterised in that the apertures or holes are from 0.5 to 2.0mm deep.
- 30 16. A radial sealing ring assembly (8) according to claims 8 or 9 characterised in that the apertures or holes are preferably substantially the same size and shape.

17. A radial sealing ring assembly (8) according to claim 1 characterised in that the assembly is adapted to tolerate from 20 to 70 bar under conventional operating conditions.
- 5 18 A radial sealing ring assembly (8) according to claim 1 characterised in that the radial seal is provided with a containment ring (18).
19. A radial sealing ring assembly (8) according to claim 1 characterised in that the containment ring (18) is on the second or outer circumferential face of the radial
10 sealing ring.
- 20 A radial sealing ring assembly (8) according to claim 1 characterised in that the containment ring (18) is on the first or inner circumferential face of the radial
15 sealing ring.
21. A radial sealing ring assembly (8) according to claim 20 characterised in that the containment ring (18) comprises a support ring (23) around the second or outer circumferential face of the radial sealing ring.
- 20 22. A radial sealing ring assembly (8) according to claim 1 characterised in that the support ring (23) is preferentially a coiled spring.
23. A radial sealing ring assembly (8) according to claim 1 characterised in that the seal is provided with a containment ring (18) around the second or outer
25 circumferential face of the radial sealing ring.
24. A radial sealing assembly (8) which comprises a pair of primary sealing lips (9 and 10), one of the pair radially disposed on a first or inner circumferential face, the second radially disposed on a second or outer circumferential face, of the radial
30 sealing assembly, the primary and secondary lips (14 and 15; and 35 and 36) being connected by a containment ring .

25. A method of introducing a three way joint into a pipeline which comprises a hole in a pipe and attaching a second pipe over the hole wherein the radial sealing ring (8) according to any one of the preceding claims lies between the two pipes.

5

26. A method according to claim 25 characterised in that the method comprises using a plurality of radial sealing rings (8) according to claim 1.

27. A method according to claim 26 characterised in that the method comprises
10 using an outermost radial sealing ring which is provided with outer facing sealing lips and an innermost radial sealing ring which is provided with inner facing sealing lips.

28. A method according to claim 19 characterised in that the innermost and
15 outermost radial sealing rings are separate.

29. A seal assembly (8) substantially as described with reference to the accompanying examples.

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P36131WO.6

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03547

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16J15/12 F16L41/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16J F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 549 562 A (CEA) 13 December 1968 (1968-12-13) page 2, left-hand column, line 48 - line 60; figure 2	1,2,5-8, 13,18, 19,25
X	GB 1 214 986 A (BAL) 9 December 1970 (1970-12-09) cited in the application page 1, line 55 - page 2, line 23; figure	1,2
A	US 5 040 828 A (KANE) 20 August 1991 (1991-08-20) column 2, line 47 - line 64; figures 2,3	1,21,22, 26

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance.

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

29 November 2000

Date of mailing of the international search report

06/12/2000

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Authorized officer

Narminio. A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/03547

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1549562 A	13-12-1968	NONE	
GB 1214986 A	09-12-1970	NONE	
US 5040828 A	20-08-1991	NONE	

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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08.JAN.2002* 3413

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing
(day/month/year) 03.01.2002

Applicant's or agent's file reference
SPG/P36131WO

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/03547

International filing date (day/month/year)
15/09/2000

Priority date (day/month/year)
16/09/1999

Applicant
FTL SEALS TECHNOLOGY LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SPG/P36131WO		FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/03547	International filing date (day/month/year) 15/09/2000	Priority date (day/month/year) 16/09/1999	
International Patent Classification (IPC) or national classification and IPC F16J15/12			
Applicant FTL SEALS TECHNOLOGY LIMITED et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 13 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input checked="" type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application 			
Date of submission of the demand 11/04/2001		Date of completion of this report 03.01.2002	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656-epmu d Fax: +49 89 2399 - 4465		Authorized officer Jest, Y Telephone No. +49 89 2399 8425	



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/035.

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-9 as received on 16/10/2001 with letter of 10/10/2001

Claims, No.:

1-29 as received on 16/10/2001 with letter of 10/10/2001

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

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☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to the report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 29.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 29 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

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- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3
- ☐ complied with.
- ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Yes:	Claims	1-23,25-28
	No:	Claims	24
Inventive step (IS)	Yes:	Claims	1-23,25-28
	No:	Claims	24
Industrial applicability (IA)	Yes:	Claims	1-28
	No:	Claims	

**2. Citations and explanations
see separate sheet****VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/03547

Re Item III

Independent claim 29 does not comply with Rule 6.2a) PCT and no opinion may be given therefore.

Re Item IV

There is no common inventive concept between the subject-matter of claim 1 and the one of independent claim 24. The inventive feature of claim 1 relates to the labyrinth seal as means for dispersing fluid pressure while claim 24 defines a containment ring member.

Re Item V**1) To independent claims 1, 24 and 25.**

- 1.1) All the features of the preamble of claim 1 may be recognised in the prior art document **FR-A- 1 549 562 (FR)**, see especially the embodiment of fig.2, or **GB-A- 1 214 986 (GB)**, see especially the drawing. The grooves provided on the radial faces of these seals are considered to be suitable for dispersing pressurised fluid.

The difference of the claimed assembly and method is that the means for dispersing the pressurised fluid is a labyrinth seal located on the axial end face. Labyrinth seals are of course well-known in the art but there is no indication in the cited prior art to locate such a labyrinth seal on said face of the assembly in order to disperse the pressurised fluid.

The assembly of claim 1 and the method of claim 25 thus meet the requirements of Art. 33(1) PCT.

- 1.2) Independent claim 24 is drafted in such a broad and speculative way that it covers many constructional arrangements which are however in no way disclosed or suggested in the description (see also comments in item VIII below).

Its subject-matter has not been limited to a construction having a radial sealing ring comprising a labyrinth seal for dispersion of the pressure but refers to merely a vague and imprecise definition of a "containment ring".

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The features of claim 24 may be recognised in FR or GB so that the requirements of Art. 33(1) are not met.

2) To the remaining dependent claims 2-23 and 26-28.

These claims are dependent either on claim 1 or on claim 25 so that the requirements of Art. 33(1) PCT are met.

Re Item VIII

- 1) There is an inconsistency between **claim 24** and the description which leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear (Article 6 PCT).
The containment member according to the description and drawings is for instance member 18 in fig.3, which is not the joining section 11 connecting the lips of the seal.
Additionally claim 24 does not relate to the inventive idea of a labyrinth seal for dispersing the fluid pressure so that it lacks an essential feature.
- 2) In claims 2,3,6,7,12 feature "means for dispersing pressurised fluid" is no longer correct and should read "labyrinth seal" (Art.6 PCT).
- 3) In the description, page 3, line 12, the labyrinth seal is presented as being optional which is in clear contradiction with the definition given by the claims (Art. 6 PCT).